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USAID Lowland WASH Activity and USAID Sustainable WASH Systems Learning Partnership Briefing Note
REAL-TIME MONITORING FOR IMPROVED WATER SERVICES IN THE ETHIOPIAN LOWLANDS

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This note provides a briefing on the use of cellular and satellite connected sensors for near-time monitoring of rural water services in Ethiopia. It is intended to help policy- and decision-makers at national and regional levels to make appropriate use of this new technology to strengthen water services.

The lowlands are a government priority

The arid, drought-prone and mainly pastoralist lowlands of eastern Ethiopia (including Afar, Somali and parts of Oromia and SNNPR) are home to the some of the poorest communities in the country. Below-average rainfall over recent years has exacerbated water insecurity in the lowlands and contributed to conflicts. The lowlands are also the focus of major development efforts that seek to displace emergency humanitarian interventions through sustained development. The government's flagship Climate Resilient Water, Sanitation and Hygiene (CR-WASH) initiative includes investing upfront in deep boreholes and more resilient piped water infrastructure to deliver services over coming decades. With a commitment from the treasury to invest 500 million USD per year, and additional funds expected from donors, this is the biggest government investment in the water sector after major dam projects such as the Grand Ethiopian Renaissance Dam.

A gap in resilience

However, the wider system to sustain this new infrastructure needs to be strengthened at the same time as it is built. Repairs are too often delayed because of a lack of information on service function, challenges with budgeting and revenue collection, limited technical capacity, and a frequent priority on installing new infrastructure at the expense of maintenance.

The ability to manage and maintain current water supply facilities in the lowlands – typically boreholes and relatively complex electro-mechanical installations to pump deep groundwater – is relatively weak. The expectation is that operation and maintenance of rural water systems is done by voluntary committees under a community management model (the same model as used for the much simpler hand pumps used in the highlands) but typically the government needs to step-in and support communities when facilities fail. Frequently, government capacity comes from the regional levels and might involve delivery of

services over hundreds of kilometers and months of waiting. The building of capacities at the decentralized zonal or woreda levels to provide a faster response remains work in progress.

In the absence of an effective structure to incentivize and finance maintenance activity, there is little routine or preventive maintenance of water supply facilities happening. Such maintenance is critical as it can increase the life expectancy of facilities and reduce costs overall at the same time as improving service reliability for users. Poor pastoral communities understandably seek to limit their expenditure on maintenance and rely on getting government support when there is a failure. As long as they can manage the inconvenience, it is financially optimal for communities to wait until there is a big breakdown rather than investing their money in servicing, preventive maintenance and small repairs. At the same time, there is very little local private sector capacity that communities or the government might draw upon to undertake such work.

As a result, water facility functionality is much lower than it should be. This is a problem for both the regional governments and local communities.

Why more monitoring?

Improvements in maintenance systems are difficult to justify and manage in the absence of good information systems. It is often unclear how good or bad the maintenance situation is due to a lack of reliable data. Information systems are needed to both track key performance indicators – like functionality – and provide information on water facility assets for operational decision-making. It is typically necessary to know details about boreholes, generators, switchboards, pumps, storage and distribution infrastructure, as well as management details. It is unlikely to be possible to manage all this information in one central management information system (MIS) so what is emerging is the use of the (planned) National WASH Inventory and MIS for performance tracking against KPIs, and the use of supporting databases to provide detailed asset management data such as the Somali Functionality Inventory[1] and the Afar Regional Water Bureau's Water Service Asset Management System[2].

Such databases need to be updated regularly at least with respect to critical indicators like functionality. The Somali Functionality Inventory currently depends on data updates by Zonal Focal Persons at the regional level who call woreda water office staff by phone. Woreda water offices are expected to have good current information on which water supply schemes are working and which are not.

Improved updating is possible using cellular and satellite connected sensors installed at water supply installations. In Afar, the regional government with the support of USAID Lowland WASH Activity is installing these remotely reporting sensors on all motorized water supply boreholes. By the end of 2018, over 150 sensors are expected to be installed on motorized boreholes in Afar[3]. The use of sensors is also

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[1] Developed by the Somali regional water bureau with support of UNICEF and partners

[2] Developed by the Afar water resources bureau with support of the USAID Lowland WASH Activity, the USAID Sustainable WASH Systems Learning Partnership and other partners

[3] There are an estimated 150 to 180 motorized boreholes in Afar region that are used primarily for potable water purposes.

being piloted in Somali region on the critical emergency drought response boreholes with the support of the USAID Lowland WASH Activity and UNICEF[4].

The sensors being used in Afar and are supplied by the company SweetSense[5] and measure the electrical power provided to the pump from either a diesel generator or solar power system. This provides data on whether the pump is used (functioning) and the number of hours of operation every day. Based on knowledge of relationship between power consumption and water pumped by the installation, the total volume of water produced can be estimated[6]. With additional information on water scheme users, this makes it possible to estimate service levels such as the maximum average consumption of water per day.

In Somali region, UNICEF is trialing use of such sensors to support the operations of rural water utilities which are being piloted in Somali region based on the new national guidelines from the Ministry of Water, Irrigation and Electricity. In collaboration with UNICEF and the SRWB, the USAID Lowland WASH Activity has installed 10 satellite sensors in Somali on critical boreholes.

The USAID Lowland WASH Activity has worked with SweetSense, and mWater who developed the customized data collection tool being used in Afar[7], to develop functionalities to seamlessly import sensor data into the mWater platform[8].

The cost of one SweetSense sensor, depending on the model is currently between 800 and 1000 USD. Installation, based on actual costs of staff, transport and expenses, has been estimated to be a similar amount (900 USD due to the large distances and challenging logistics involved) so the total cost of an installed sensor is approximately 1800 USD. This investment cost is small compared to total investment cost (estimated over 100,000 USD) of a typical rural water supply scheme sourced from a deep borehole.

Data communications: a critical choice

Sensors can transmit data in different ways and this has a major influence on the ongoing costs of using sensors to update rural water supply databases. The SweetSense sensors can be supplied with either GSM-enabled (mobile phone) or satellite-enabled data communications. The satellite models at the moment use the Iridium network. Data costs for GSM-models are typically 2 USD per sensor per month, but satellite data costs are currently 10 times more, i.e. 20 USD per sensor per month. New technologies are also becoming available. SweetSense is developing a model of its sensor to work with the new satellite provider Swarm[9]. Towards the end of 2018, this promises satellite communications at a cost similar to

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[4] The USAID Lowland WASH Activity has installed 10 sensors at critical sites as a pilot. It is estimated Somali region has 350 motorized boreholes that are used primarily for potable water sources.

[5] A US company selected through a competitive tendering process. Other sensor technologies are available.

[6] The USAID Lowland WASH Activity has trained local staff to collect water pumping data at the sites where sensors are installed using ultrasonic flow meters. Additional data such as well water levels, ground water temperature, TDS and e-coli water quality are also collected.

[7] In addition, the USAID Lowland WASH Activity and the USAID SWS and RWBs will adapt the Afar mWater tool for Somali region based on learnings from Afar

[8] Previously, in Rwanda, SweetSense demonstrated a 10x reduction in water system downtime (from 200 days to 20 days) using these sensors, bringing average uptime from about 50% to over 90%.

[9] Regulatory approval will be required in Ethiopia to use this technology. For more information see https://medium.com/swarm-technologies/introducing-swarm-549b804f1fa1

current GSM costs.

Apart from cost there are other important factors to consider when choosing the type of communications for a sensor. Reliable mobile phone signals are not available everywhere in the lowlands and satellite communication is the only option for sensors in some remote locations. A further issue is the reliability of the GSM network. GSM networks have been shut down for extended periods – causing loss of water facility data - owing to security concerns and government restrictions on the use of mobile data. It is also important to consider the difference between paying for local GSM data costs to Ethiopian Telecom in Birr, and paying an international provider of satellite communications with scarce foreign exchange.

Acknowledgements

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[10] Further information can be found at Thomas et al. (forthcoming) Quantifying increased groundwater demand from prolonged drought in the East African Rift Valley, and in Putnam, W (2018) Mobile Communities in Ethiopia Seek Fixed Solutions to Their Water and Sanitation Challenges [online] Available at https://medium.com/usaid-global-waters/mobile-communities-in-ethiopia-seek-fixed-solutions-to-their-water-and-sanitation-challenges-831380050174